SOCK-LIKE FOOTWEAR WITH A PADDED SOLE AND METHOD FOR MAKING THE SAME

The present invention relates to substantially soft sock-like footwear commonly used as an inner liner in conjunction with outer articles of footwear such as boots, shoes and the like.

Articles of footwear such as boots and shoes are typically constructed from a plurality of components the components are assembled using various techniques such as stitching, bonding and riveting amongst others. Footwear is typically composed of an upper part, which provides access via an opening for a foot and a lower part the sole that provides a durable and resilient material to contact the ground, as a whole when assembled together they create an internal volume to accommodate a foot. Such articles of footwear typically have a major outer surface and a major inner surface. The opening or orifice that allows entry of a foot into the footwear's inner volume or cavity often incorporate fastening devices to constrict the said opening this substantially assists to secure a foot within the article of footwear, devices such as laces, elastic, hook and loop fastenings, toggle clamps and the like are typically employed. Upon the surface of the interior volume of the footwear there is commonly affixed a permanent lining material this is typically attached or laminated to the components or materials that are a part of the outer surface of the footwear prior to the assembly of the footwear. The composition of such inner linings can be specified to enhance performance and impart properties such as strength, stiffness, ventilation, insulation, bacterial control, permeability and comfort to the footwear and other properties. Articles of footwear with prior affixed linings that are assembled from two or more components which include such pre-laminated materials and comprise of interfaces or joints where the various components are joined the joints need additional attention during the assembly of the footwear so that if required the joint is water proof or resistant. Such additional processes are time consuming and difficult to rectify after an item of footwear is fully assembled. Typically articles of footwear with pre-affixed linings are often specified and constructed for particular environments and uses and as by way of a simple example; the specification of a material for a walking boot for use in a hot environment would be a thinner and lighter material than that used for a similar boot specified for use in cold environments. Therefore a boot intended for a desert climate would therefore not perform well in an artic climate and visa versa for a boot intended for a cold climate.

By way of an alternative method of construction some articles of footwear are fabricated with a sock-like internal liner commonly referred to as a 'bootie' or 'inner boot'. Such bootie's can be removably affixed or positioned or alternatively permanently affixed to the internal surface of the outer article of footwear. Advantages of footwear utilizing such a dual construction where the inner liner is fabricated separately from the upper and sole (the footwear's outer components) are numerous and varied and include the ability to adapt the properties and performance of the footwear article as a whole such as when one bootie is removed and replaced from inside an outer boot or shoe with a different second bootie where the second bootie has been manufactured to an alternative specification than the first. Further advantages include, footwear articles with such a dual construction can be dried if wet or damp more effectively and cleaned more efficiently when the booties are

manufactured to be detachable from within the outer boot or shoe. Additionally it is complicated to construct the many parts that make up the uppers and sole (outer components) of shoes, boots and the like and consistently manufacture them to be water proof or water resistant if they are required to be and to keep the wearers feet dry in wet conditions. Shoes, boots and the like that are claimed to be water proof or water resistant and are not and leak allowing water into the footwear during use are the source of many returned footwear articles to the manufacturers. It is a far simpler and a better economic solution to manufacture the inner bootie to be water proof or water resistant than the whole of the footwear's outer, it is also simpler to test this inner component for its integrity prior to it's final assembly inside the footwear that will incorporate such a bootie. A further advantage to such a construction is that the shaped polymer padding on the sole of the bootie can reduce the specification of the outer item's of footwear insole or footbeds and in some footwear even replace the them.

It is known from prior art that various embodiments of bootie's exist the following documents generally disclose novel features, constructions or specific applications for articles of footwear that utilise an inner liner such as a bootie.
Prior art of particular relevance includes; US4599810 to Guillaume, WO02080720 to Sheets & Finney, US5526584 to Bleimofer & Danielax, WO9619127 to Herbert, EP0976337 to Labarre. These documents are applicable to booties but generally do not disclose novel methods of fabricating the said booties.
Prior art; WO9851177, WO0232246 both to Polegato and US5588226 to Schenkel, these documents describe various constructions of soles and mid soles that are perforated and configured to allow the passage of gases but not liquids (particularly water) through the perforated holes, and refer to outer components of footwear not inner bootie liners. Prior art; ES2024806 to Jellici, US4454619 to Bichet, US4761845 to Funck, EP0730833 to Delique, FR2614768 to Lassade. These documents generally disclose devices for holding, pressing and bonding articles of footwear during their fabrication primarily employing an elastic membrane to exert pressure upon the components during their construction.

According to the present invention there is described a sock-like inner liner with shaped padding attached substantially to the sole portion of the inner liner, methods of constructing such a sock-like inner liner as to be used in conjunction with outer articles of footwear, such as boots, shoes and the like where the liner can be removably affixed inside the outer article of footwear or alternatively permanently affixed to the inside of outer article of footwear. More specifically the invention discloses a method to over mould integral comfort padding with a durable outer surface to the bootie. Where the padding is substantially attached to the bottom or the sole of the liner. Where the padding is substantially attached to the bottom or sole of the liner and continues around the sides of the bootie. Where the padding is substantially attached to the bottom or sole of the liner and continues around the sides of the bootie more so at the toe and the heal portions of the bootie. Where such padding is three-dimensionally formed and bonded to the liner in an operation using an elastic membrane to exert controlled pressure and transfer controlled heat to the padding and liner simultaneously. During the process the padding is selectively consolidated in specific locations and formed to a predetermined shape so that its outer surface can intimately fit inside other articles of footwear (if so required). Where the padding is shaped and consolidated more around the sides of the liner than on the bottom of the liner so that around the sides of the booties the padding is less thick that on the bottom. In an alternative embodiment where such padding is three-dimensionally formed and bonded to the liner in an operation whereby a heated polymer material is injected under pressure into a cavity that incorporates a fabric liner while the sock-like liner is supported internally by a former, in particular the

area of the bootie to where the padding is to be attached is enveloped by a tool that creates the said cavity the tool creates a seal around the periphery to retain the injected polymer within the cavity of the tool. Whereby the cavity imparts a predefined shape to the padding when the polymer material has cooled and or stabilized, the tool creating the cavity is removed and the outer shape of the polymer padding reflects the internal shape of the cavity and is bonded to the sole or underside of the bootie. The formed over-moulded padding improves the wearer's comfort and the durability of the bootie.

The combined moulding and affixing of a pre-shaped or pre-formed polymer component to the sole of a fabric envelope utilizing heat and pressure exerted by a membrane is a low capital cost manufacturing solution for both the plant and tooling. This manufacturing solution maintains high volume production outputs but is also flexible and allows easy customisation of the footwear items for both simple and sophisticated product configurations. It also facilitates the technical advantage of being able to selectively compress the pre-form polymer material this is important as the periphery of the padded sole can be consolidated so that there is a smooth transition of the thickness of the padded polymer sole when it is attached to the fabric envelope, from it's thickest on the bottom of the footwear to it's thinnest at it's periphery this improves the footwears ergonomics and comfort as it is able to better intimately fit inside outer items of footwear without causing local areas of high pressure to a wearer's foot.

A further advantage of this manufacturing method is that when the polymer padding or pre-form component is consolidated the material is also densified and it's durability and abrasion resistance is simultaneously enhanced this is an important feature particularly for the areas that correspond or are adjacent to the back of the heal and a big toe's nail area of a wearer's foot.

Where an injection moulded manufacturing solution is employed a high level of automation is possible although plant and tooling costs are high and customisation is less flexible, very high production rates are possible and there is less preparation of components required, however this process has the disadvantage that it cannot consistently produce a thin cross sectional moulded product which is essential to optimise the comfort and ergonomics of this type of footwear product and prevent blisters occurring. Additionally the integrity of the interface between the fabric envelope and the polymer to the ingress of water through capillary action can be inconsistent particularly when bonding to a PTFE based membrane film.

A brief description of the drawings.

Figure1, shows in perspective a bootie with a shaped padded sole.

Figure 2, shows a side view of a bootie with a shaped padded sole.

Figure 3, shows a plan view of the major fabric components prior to fabrication used to assemble the bootie.

Figure 4, shows a perspective view of an assembled bootie and insert component and pre-form for the moulded sole prior to assembly with the bootie.

Figure 5, shows a schematic drawing of the device and process.

Figure 6, shows a partial section of the bootie on a last and being compressed by the membrane, shows method without pressure masking.

Figure 7, shows a partial section of the bootie on a last being compressed by the membrane, shows method with pressure masking and showing a butt joint.

Figure 8, shows a perspective for an assembled bootie with a repeated diamond pattern in three-dimensional relief upon the shaped padding with vent holes.

Figure 9, shows a partial plan view for an optional pressure mask illustrating a three-dimensional relief where the circles represent raised or lowered areas on a substantially planar plate.

Figure 10, shows a partial section of the bootie on a last being compressed by the membrane, shows method with pressure masking and showing a folded back lap joint.

Herein is described in detail the 'bootie' or 'inner boot' article of footwear and a method of manufacturing the same with reference to the accompanying drawings.
The article of footwear is configured to cover the leg from anywhere between the thigh to the ankle and or foot of the wearer/user and is composed of an upper portion (Fig1 a) where there is located an orifice (Fig1 c) through which a foot can be inserted and a lower portion the sole (Fig 1 b), so when top and bottom portions are considered as an assembled whole the two portions create an envelope with an interior volume. Generally, the envelope is configured as an angled tube with an open end and a closed end where the closed end is formed to accommodate a wearers toes (Fig 2 a) and the apex of the angle is formed to accommodate a wearer's heel (Fig 2 b). The orifice is formed to accommodate a wearer's ankle or the circumference of a leg at any point up to the thigh, e.g. the ankle, below the calf, the calf, above the calf, below the knee, the knee, above the knee, the thigh. Commonly the tubes opening may be configured with one or more longitudinal cuts or slits extending partly towards the closed end of the tube, alternatively these can be configured as partial bellows utilising folds instead of or including cuts, these are positioned to aid the entry of a foot by allowing the orifice to expand its circumference. A method of constricting the opening such that can be achieved with elastic or cord when affixed around the circumference of the opening can be employed. Alternatively this may also be achieved by affixing elastic or cord to both sides of one or more of the longitudinal cuts or folds that aid the entry of a foot to constrict or tighten the opening after a foot has been inserted. Other suitable fastening devices may be employed such as hook and loop fastenings (Velcro, a trade name) press studs, zip fasteners and buttons amongst others. Preferably the envelope is constructed from a plurality of component parts that are affixed substantially edge to edge by stitching, creating seams (Fig 4,d,e,f), this can be achieved by various methods such as bonding by heat; adhesive, radio frequency vibrations, ultrasonic frequency vibrations, laser, taping and riveting and by any other suitable bonding methods. In a preferred embodiment there are two side components (Fig 3,a,b) and one bottom component (Fig 3,c) joined by stitching at their peripheries and the seams taped over to make the joints water tight (Fig 1,d), where the tape material is bonded by an adhesive that bonds and creates a water tight interface. In an alternative embodiment the envelope is constructed in a similar manner as previously described however there are different permutations of component parts that assemble to fabricate a similar sock-like envelope as described. In a further alternative embodiment of the invention the envelope is constructed from a substantially tubular monocoque structure such as formed when knitting a sock. In the preferred embodiment of the invention the bootie envelope is manufactured using substantially textile materials. The textiles or fabric materials are used individually in a single layer or in combination with other fabrics or textiles or polymer materials these are typically laminated into composite structures wherein knitted, woven or non-woven, materials are bonded in layers to themselves and other materials such as polymer films to produce hybrid fabrics with specific properties. Generally such a laminate structure would comprise of an inner surface layer and a middle layer combined with an outer textile and/or polymer film layer (Fig 10, b). Alternatively one-piece textiles manufactured with a multi-layered structure can be employed independently or in combination with other fabrics or polymer films. In another alternative embodiment a simpler textile structure would be comprised of two layers where a polymer film is laminated to one side of a textile, this simple textile construction could be further enhanced with an additional external layer of fabric laminated to the polymer film, this would enhance the abrasion

properties of the polymer film. Typically the polymer film is itself a multi-layered structure with specific engineered properties. In a preferred embodiment the polymer film is engineered to be impermeable to water and permeable to water vapour and other gases such as air. Therefore allowing a wearer's foot to stay dry in wet conditions and yet still allowing the bootie envelope to breath and transport water vapour through the film and preferably away from the wearer's foot.

Between the laminations of the various materials at the interfaces of the textile to textile structures and textile to polymer films adhesive layers are often employed to bond the laminations together, alternative bonding methods can also be employed bonding by heat, radio frequency vibrations, ultrasonic frequency vibrations and others, however, preferably the method engaged does not substantially inhibit the precise porous properties of the laminated composite textile, should it be desired.

The afore mentioned composition's for the bootie's fabric envelope should not be considered as limiting as there are many additional combinations of fabrics, materials and manufacturing methods that can be employed to construct a similar component.

Herein the words mandrel and last are to mean a foot or foot-like or sock-like shaped structural support or jig, on or over which footwear components are positioned, assembled and supported while manufacturing processes are executed.

In a preferred embodiment of the invention the booties shaped padding that is positioned predominantly on the sole of the bootie (Fig 1,b) is comprised of a polymer pre-form (Fig 4 a), this is a sheet material of between 0.01 and 25 millimetres thickness. Preferably the pre-form has been pre-coated with a re-activating adhesive on its inner surface (Fig 4 b, Fig 6,c Fig 7,c, Fig 10,c) and then formed substantially to the shape of the booties sole in a primary moulding process, whereby the process substantially retains the integrity of the adhesive coating. In an alternative embodiment the pre-form is an injection moulded polymer component. In a further alternative embodiment the pre-form is a compression moulded polymer component and in a further alternative embodiment the pre-form is a thermoformed moulded polymer component. The moulded perform component is preferably coated with an adhesive on its internal surface. Preferably the adhesive coating is a continuous and substantially constant deposit. Alternatively the adhesive is selectively applied in specific locations. The adhesive is applied with a coat weight of preferably not less than 10 and not more than 900 grams per square metre, more specifically a coat weight of between 150 and 350 grams per square metre is preferred with a softening temperature of between 70 oC and 125 oC where the adhesive has a low viscosity at or around 100 oC). Preferably a heat re-activating adhesive system is employed, alternative adhesive systems can be employed and the adhesive can also be applied to the pre-form component or the sole of the bootie or both. Preferably the pre-form is composed of a durable polymer such as, EVA, EVA copolymers, TPU's, TPE's, TPR's, TPV's, EPDM's or other elastomers with similar resilient and flexible properties. In an alternative embodiment a vulcanising rubber material is employed, in a further embodiment a partially cured or cured thermoset elastomeric polymer is employed such as a PU. The pre-form can be a solid or a cellular material. In a preferred embodiment the structure of the pre-form material is substantially a cellular material and more particularly substantially a closed cell material structure. In a further alternative of the preferred embodiment the structure of the pre-form material is substantially a cellular material and more particularly substantially an open cell material structure. Between the outer pre-form and the sole of the bootie envelope additional spacer or intermediate materials and structures can be optionally positioned such as felts, open or closed cell materials waffle structures, gels, bladders, bellows and the like (Fig 4,c, Fig7,g, Fig10,g) these are alternatively pre-laminated or combined to the textile component that is the lower portion or sole of the envelope (Fig 3,c, Fig 6,h, Fig 7,h, Fig10,h) the lamination can be prior to the components cutting out or joining to the other components making up the booties envelope. The intermediate materials can be made from materials that have a higher

heat resistance, higher density, or lower density than the pre-form material and possess alternative or improved properties than the pre-form material. These can be incorporated in specific locations on the sole of the bootie to impart various and differing properties to the sole of the bootie than the pre-form could individually accomplish, properties such as ventilation, softness, firmness, ergonomic, fit, comfort, rebound, compression set, thermal regulation, thermal insulation, anti-bacterial, fatigue, moisture wicking and others. More specifically and as by way of an example the sole directly under the heal area of a foot requires materials with improved compression set and impact absorption properties than is generally required for the remainder of the sole. The pre-form can be a single component or alternatively produced from two or more components or sub-components or sub-assemblies that can be different materials, colours, thickness, shapes, texture or with different physical properties, such components can be positioned and placed together on the sole of the bootie envelope. These can be collated on the sole of the bootie prior to exposing the bootie assembly to heat and pressure. In addition and or alternatively components may also be attached after the assemblies exposure to heat and pressure. The components can be placed and positioned in a repeatable and consistent means by mechanical actuators such as a robot arm controlled by an electronic programmable computer typically known as a pick and place robot, or manually by a human operator, or partly by both. To assist a manual placement of the components onto the sole of the bootie envelope prior to the assemblies exposure to heat and pressure the location of the components can be indicated visually by projecting light in a predetermined pattern corresponding to the intended position/s of the component/s upon the sole of the booties fabric envelope, alternatively or in addition graphic markings, textures, holes or other recognisable features on the components can also aid alignment and registration of the component parts during assembly.

In a preferred embodiment of the invention a method to securely affix the pre-form, additional intermediate materials and components is described in detail.

The pre-assembled bootie envelope is securely placed onto a close fitting foot shaped mandrel or last (Fig 5,a, Fig 6,a, Fig7,a, Fig10,a) for support. The last/mandrel can be heated and cooled in a controlled manner this is accomplished using hot air, hot liquids, electrical elements, infra-red radiation, steam, electro-magnetic induction and any other suitable methods this list should not be considered as limiting. The sole (Fig 6,h, Fig 7,h, Fig10,h) of the bootie envelope for convenience can be located facing upwardly to improve visibility when positioning the shaped padding components or pre-form/s (Fig4,a Fig5,b Fig 6,d Fig7,d, Fig10,d) onto the bootie envelope (Fig 5,c Fig6,b Fig7,b,h, Fig10,b,h) that is supported internally by a last/mandrel. In an optional embodiment of the invention adhesive is applied to the sole of the bootie envelope and/or one or more adhesive (Fig7,e Fig10,e) coated spacer/intermediate (Fig7,g Fig10,g) components are positioned in a repeatable fashion onto the bootie envelopes sole. The adhesive can be a liquid, paste film or in any other suitable form capable to be utilized. The positioning of the intermediate components or sub-assemblies can be temporarily aided by employing a pressure sensitive adhesive until securely bonded, the pre-form (Fig5,b Fig6,d Fig7,d, Fig10,d) is positioned over the intermediate components or sub-assemblies that are positioned on the sole of the booties envelope and the pre-form component/s is now positioned over the whole assembly with the intermediate component/s sandwiched between the pre-form and the bootie envelope any external components such as pre-printed graphics, labels or other shaped materials with specific advantageous properties are placed onto the outer surface of the assembly.

In a preferred embodiment of the invention the pre-form component/s is positioned onto and over the sole of the bootie envelope with the pre-coated adhesive in near proximity to the envelopes surface, the sides of the pre-form extend around the sides of the bootie envelope and over the heel and toe areas of the envelope. More preferably the pre-form is configured to fully encompass the booties bottom seam

(Fig1,e Fig2,c Fig4,d Fig6,j Fig7,j Fig10,j) that is the join between the component that is the lower portion of the envelope to the other constituent parts of the booties envelope. Encompassing this seam negates the necessity to seal the seam with a waterproofing tape this reduces the complexity and cost of fabricating the bootie simplifying the method of sewing the bootie bottom or sole component to the side components of the bootie as the bottom seam can be sewn from the outside of the bootie and negates a sewing and sealing operation that had to be previously preformed with part of the sewing and/or sealing machine inside the bootie itself. The more complex sewing operation produces a seam whereby the edges of the bootie components are connected edge to edge (Fig7,j), a 'butt joint' with substantially no overlapping of the components, a time consuming operation when compared to the simplified joining technique where by the components are overlapped, a 'lap joint' (Fig10,j) and joined by sewing this creates a lap joint or seam that initially protrudes outwardly from the external surface of the bootie and the protruding seam is then bonded to the side of the bootie (Fig10,j) when the pre-form or padding is bonded to the bootie, with such a construction it is not desirable for the bootie to have protruding seams or similar protrusions on or about the inside of the bootie as this can be the source of discomfort to the wearer of such an article. Further, preferably as the pre-form is a non-permeable material and therefore water-proofs the sole and sides of the bootie when securely attached to the bootie envelope, the lower textile sole portion of the envelope can be manufactured from a textile or other material without a breathable water-proof polymer film laminated to it (Fig 10, q), this further reduces the complexity and therefore the cost of fabricating the bootie.

The seam is pre-treated prior to the exposure of heat and pressure by applying it with a chemical substance that aids its adhesion to the pre-form component and also assists the seam to be water proofed or water resistant. Preferably the lower textile sole portion of the envelope is manufactured from a textile or other material that is air permeable and compliments an intermediate material/structure or assembly that aids, creates or improves air circulation inside the bootie envelope when in use, where by the action of walking, running and the like air is pumped or moved between the inside surface of the outer shoe or boot and the wearers foot, such as a substantially open cell foam can achieve when compressed an then allowed to recover and expand to its former shape. In such an arrangement more preferably air is also exhausted out of the shoe or boot and replenished with fresh air from outside the boot. In a further refinement of the embodiment the volume of air that is replenished during each step is adjustable. The intermediate component is a cellular structured material while the outer pre-form component is also cellular structured material that is a substantially a higher density micro-cellular foam (between 80 kg/m3 and 300kg/m3) and or a solid elastomeric material.

In an alternative embodiment the pre-form component is bonded to the bootie envelope on and around the sole of the bootie over the lower seam creating a waterproof seal on or around the lower seam attached externally to the outer surface of the pre-form is a shaped pad. The pad or padding in such an embodiment creates a cushion for the wearer's foot and the pre-form component seals the bottom seam and provides a compatible and stable surface for the padding to be attached.

In such an assembly the pre-form can be a pre shaped polymer component or a coated liquid or paste applied to the bootie by dipping, brush, spraying, extrusion or any other suitable means where the liquid or paste subsequently solidifies to a resilient flexible material and creates a waterproof seal to the bottom and the seam of the bootie, the shaped padding is applied by direct injection to the attached pre-form within a mould cavity, alternatively the padding is directly applied by compression moulding to the attached pre-form or where the padding is pre-shaped by injection moulding, compression moulding, cutting, thermoforming or any other suitable means and post applied to the pre-form, a combination of one or more of the fabrication techniques can be utilised simultaneously. The padding can be pre shaped

and during its application to the pre-form component it is further shaped while adhering to the sole of the bootie such as is common with some types of moulded rubber soles for outer shoe or boot construction. In another alternative embodiment the pre-form is used as a medium to condition the interface between the bottom of the bootie and the padding so that it securely adheres to and waterproofs the bottom of the bootie simultaneously. The pre-form material and/or the padding material during the bonding process changes their physical properties for example the pre-form initially softens becoming less viscous and then solidifies, the padding materials molecules cross-link during the bonding process. In a further arrangement the pre-form is itself produced from a shaped hot melt adhesive or other substance with similar properties. The padding material can also be used as a spacer or support material creating distance between the sole of the outer boot or shoe and the wearer's foot. The padding, intermediate components or spacer materials utilised in any of the disclosed embodiments is a thermoplastic polymer, or a thermoset polymer or a vulcanising rubber or any other suitable materials such as cork, felts, fabrics, card and the like. In a further alternative embodiment the pre-form is bonded directly to the bootie envelope on and around the sole of the bootie encompassing the lower seam creating a waterproof seal this is achieved by directly injecting via an injection moulding device a polymer material, such as EVA, TPU, TPE, TPV, PU, and any other suitable elastomeric polymers and polymer compounds, and/or a reaction injection moulding (RIM) device, (commonly used to process two component PU polymers) with such devices moulds would be employed to define the shape of the padding. In any of the disclosed embodiments the bootie and/or the pre-form can be pre-treated with an adhesion/sealing promoting agent.

In a further improvement to the embodiments herein described, as a means of providing enhanced ventilation around a wearer's foot, more specifically as a means of providing improved ventilation between the inside surface of the outer shoe or boot and enhancing the ventilation around a wearers foot. In particular the improvement provides superior air circulation to the sole of the wearer's foot and therefore imparts greater comfort by more efficiently regulating the temperature and humidity while a user is wearing items of footwear that incorporates a herein described inner bootie. To facilitate increased ventilation the flow of air other gases and or vapours is permitted through the bottom or sole of the bootie through both the fabric envelope materials and the attached padding. Gases and vapours are allowed to travel to and or from the internal volume of the bootie to the interface between the outside surface of the bootie and the inside surface of the interior volume of the outer item of footwear. Groves, recesses, textures, raised and or lowered relief's or contours on any of the said surfaces will create passages aiding and increasing the volume of gases and or vapours that can flow (Fig8,b). This can be accomplished through moulding, forming, embossing, cutting, etching, attaching, lamination, fabric textures and through the internal spaces of fabrics and fibres also any other techniques that will create similar routes for the flow of gases and or vapours where the outer footwear and the inner bootie are in close proximity to each other. The booties fabric envelope can be manufactured from a significantly porous or permeable material that allows the flow of gases, vapours and liquids and small particulates through its structure and is substantially not water proof or water resistant, alternatively the booties fabric envelope can be manufactured from materials that are significantly permeable to only gases and vapours and is substantially water proof or water resistant. The polymer padding is substantially a non-permeable or porous material. The polymer padding attached to the sole or bottom of the bootie's fabric envelope is therefore configured with one or more holes or perforations (Fig,8,c) through it's structure from one of the major surfaces through to the other of the major surfaces (Fig,4,g). The holes permit the passage of gases and vapours through the fabric of the bootie's envelope and the polymer padding. When constructing a bootie that is intended to be substantially water proof or water resistant yet permeable to gases and vapours the holes or

perforations are located so that they are not in close proximity to the perimeter or edge of the polymer padding and that they are also not in close proximity to the underlying seam or joints of the booties fabric envelope so that the waterproofness or water resistant integrity of the bootie is not compromised. This is particularly important when the affixing of the polymer padding is also intended to act as a seal for the seam so that taping the seam with a water sealing tape is unnecessary. The holes or perforations in the polymer padding would also remove any adhesive coating so that the adhesive cannot interfere with the flow of gases and vapours. The periphery of the holes or perforations are securely bonded and sealed to the booties fabric envelope. Additional components that are a part of the padded sole and that are positioned between the fabric envelope and the perforated polymer padding also are configured to permit the flow of gases and vapours (Fig4,h) the insert or intermediate components will be an open cell structure or porous material or shall be configured with similar holes or perforations as the polymer padding component and with a corresponding spatial relationship (Fig4,h,g). Similarly, additional components that that are a part of the padded sole and that are positioned on the outer surface of the perforated polymer padding these components also are configured to permit the flow of gases and vapours the insert or intermediate components will be an open cell structure or porous material or shall be configured with similar holes or perforations as the polymer padding component and with a corresponding spatial relationship. It is preferred that parts of the padded sole that have been configured with holes or perforations that the holes and or perforations of the different components are substantially registered and aligned with one another (Fig7,o Fig10,o) so that different components that are part of the affixed polymer sole allow an optimised flow of gases and vapours. Where there is more than one component to collate for the pre-form /padded polymer sole the registration of such holes and perforations during the assembly of the padded sole components is achieved manually by visual alignment and or by use of a device that registers the holes, such as by protrusions that locate into the holes or perforations of the components and align the holes (Fig7,p Fig10,p), one or more protrusions that are supported in spatial a relationship that corresponds to the spatial positioning of the holes or perforations in the components that are to be aligned such a device is commonly referred to as a jig. During the application of combined heat and pressure via an elastic membrane to bond and form the polymer padding to the sole of the fabric envelope a device referred to herein as a pressure mask is employed this device selectively distributes the pressure exerted by the membrane onto the polymer padding components in a controlled and repeatable manner. During the bonding and forming process to stabilise the padding component/s and to prevent the vent holes from deforming and sealing the protrusions used to align the holes and perforation are supported by the pressure masking device therefore the pressure masking device and the padding location jig are then a combined device (Fig7m,n,p Fig10m,n,p).

The holes and perforations are positioned on the components that are part of the padded sole so that when the holes are aligned the separate components are simultaneously aligned in their correct spatial relationship to each other.

Generally, a device that utilises a pressure difference on opposing sides of a substantially planar elastic membrane with two major surfaces in combination with pressurised or evacuated chamber/s (Fig5,g,h) is commonly referred to as a membrane press, typically in operation such presses exert or apply substantially equal and even pressure across the area of the membranes (Fig5,e Fig6,e Fig7,i Fig10,i) major surfaces. Additionally with such devices the forces exerted or applied by the membrane onto the item/s being compressed are substantially perpendicular to the major surfaces of the membrane and/or item being compressed. This combined with the elastic properties of the membrane facilitates the wrap-round (Fig5,i) compression and moulding of three-dimensional shapes. Typically materials to be shaped by such a method are semi-finished materials in the form of films or sheets (as is the pre-form

component). The process inherently forms materials into shapes that reflect the underlying surface or shape that the material is formed over. A characteristic of this method of shaping materials is that when the materials thickness is increased the outer shape of the formed material resembles less and less the object it is formed over, the surface form of the material shaped by intimate contact with the membrane becomes amorphous and generalised in shape, particularly when the material is simultaneously softened by heat as it is compressed by the membrane. A further characteristic of this method of shaping materials is that the pressure applied by the membrane is substantially uniform across its area, the resultant cross sectional thickness (Fig6, d) of a formed material remains substantially uniform, although sharp or angled edges will be rounded (Fig6,l Fig7,l Fig10,l) during forming. Materials that have an internal cellular structure when heated and softened are then compressed by a membrane press that can deform and damage the cell structure with a subsequent loss of the cellular materials properties.

In a preferred embodiment of the invention the membrane press produces a defined outer surface (Fig8,a) to the pre-form and selectively (Fig7,k Fig10,k) compresses and consolidates and densifies the structure of the booties padded sole by using three-dimensional relief's and textures, something that a conventional membrane press cannot achieve. The moulded definition is achieved by utilising a substantially planar (Fig5,j Fig7,m Fig9 Fig10,m) but three-dimensional semi-rigid or rigid support positioned onto the outer surface of the pre-form prior to forming with the membrane this serves to selectively reduce or mask the pressure exerted upon the pre-form by the elastic membrane in predetermined areas and in a repeatable manner. It also increase's the pressure exerted upon the pre-form in predetermined areas and in a repeatable manner. This is achieved with a mesh like structure or perforated plates or with a plate with raised and/or lowered portions (Fig 9,a Fig7,n Fig10,n) upon its surface, the plates are shaped substantially to a similar shape as the booties sole. Where a mesh or a perforated plate is employed the elasticity of the membrane used is insufficient to deform fully under pressure into the holes of the perforated plate or mesh therefore these areas apply less pressure to the pre-form and bootie assembly the than the perforated plate or mesh which apply corresponding higher pressures. Where a plate with raised portions is employed the elevated areas on the surface of the plate are used to space the plate away from the pre-form, the highest pressures applied to the pre-form during the over moulding process correspond to the elevated areas on the plate and the lowest pressure applied corresponds with the non-elevated areas of the plate, similarly the elevated areas of a plate can be represented by the plate itself and holes in the plate can represent the non-elevated area's. These plates form defined shapes, patterns, relief's, textures, troughs, rails, dimples, pimples and the like to the outer surface of the booties pre-form sole imparting a repeatable defined surface (Fig8,a) where the cross sectional thickness of the padding is controlled by the corresponding thickness of the perforated plate, mesh or the height of the elevated areas. The bootie assembly is moulded in three-dimensions between the membrane and the mandrel the cross sectional thickness of the padding is variable and controlled by employing the spacer member, preferably the spacer member should transmit thermal energy quickly and efficiently to minimize the heating and cooling cycle of the process. The surface patterns can be configured to impart further advantages and enhancements to the bootie such as grip, improved ventilation, improved abrasion characteristics, aesthetics, design options and others. The patterns can include text and graphics or company logos. The sole area of the supporting mandrel can also be shaped with textures, graphics, relief's and ergonomic contours and the like, these will be mirrored upon the internal surface of the bootie after the over-moulding process. As a further advantage of this method of construction the internal cellular structure of padding material is selectively controlled, preventing the membrane in specific areas from over compressing the material while the material is heated to above its plastic softening temperature. Another advantage of this method

of construction is that the components to be bonded are held securely in an intimate relationship and in an evacuated atmospheric environment (partial vacuum), minimising the possibility of air entrapment between the bonded components, therefore creating good adhesion and decreasing the possibility of water permeability around the lower seam of the bootie. Without the pressure mask the membrane compresses indiscriminately and substantially equally across its surface and can destroy or alter the physical properties that are needed in the original cellular material, the pressure mask (Fig5,j) prevents this. Additionally the internal surface of the bootie is formed into an advantageous form, improving the fit, ergonomics, ventilation, and other properties of the bootie. In an optional embodiment of the invention the elastic membrane used to exert or apply pressure during the bonding process is patterned with a three-dimensional relief and consequently has areas of corresponding higher and lower rigidity dependent upon the depth or height of the relief and the thickness of the membrane in those areas. The thicker the area of the membrane the more rigid at that location and the thinner the more elastic this is accomplished by texturing or patterning the surface of the membrane in contact with the pre-form. Alternatively stiffening devices can be positioned within and or upon the membrane.

In a preferred embodiment of the invention the assembly comprising of the last or mandrel, bootie envelope, adhesives, spacer materials, pre-form and a pressure mask is placed inside a vessel or chamber (Fig5,h,g) and a heat resistant elastic membrane (Fig5,e Fig6,e Fig7,i, Fig10,i) such as silicone (or similar) is placed over the assembly and then sealed by the outer edge (Fig5,d) of the chamber. Pressure is exerted onto the assembly by the membrane and the assembly of components is supported by the last. The pressure is applied by creating an unequal pressure on one side of the membrane compared to the opposing side this is achieved by means of fluids or gases supplied into a chamber or evacuated from a chamber (or both) by external means typically by such devices as a vacuum pump, compressor, hydraulic pump and other suitable devices known to those experienced in the art. While the membrane is compressing the assembly the mandrel or last and the membrane are heated (between 80 oC and 250 oC) and then cooled to a temperature where the pre-form materials are stable (typically a cycle of between 1minute and 18 minutes). During the process the pre-form pad is securely bonded to the sole of the liner and extends around the sides, heel and over the toe area of the bootie. To aid the forming process particularly around the toe and heal areas a tourniquet (Fig5,f, Fig6,f, Fig7,f, Fig10,f) device helps to constrict the membrane in specific locations of the bootie therefore increasing the pressure or force applied to the assembly in specific locations in particular the toe and heel areas. The method of controlled pressure masking improves the fit of the bootie when inside an outer article of footwear by reducing the thickness of the over-moulding locally at the sides of the bootie and provides a smooth tapered transition of the over-mouldings thickness from its edge at the sides of the bootie to the area typically under foot the sole (Fig6,l Fig7,l Fig10,l) which is engineered to be thicker than the sides. The method of controlling the pressure applied to the bootie sole assembly allows the advantageous properties of cellular materials to remain substantially as originally manufactured in selectable locations. In a preferred embodiment of the invention the perform is a cellular thermoplastic polymer material that during the over moulding process a skin or layer of melted or solidified material forms while in close proximity to the heated elastomeric membrane and/or the pressure mask this forms a durable outer surface on the sole and sides of the three dimensionally formed sole that is better able to resist abrasion than the cellular material of the pre-form could achieve prior to the over moulding process.